

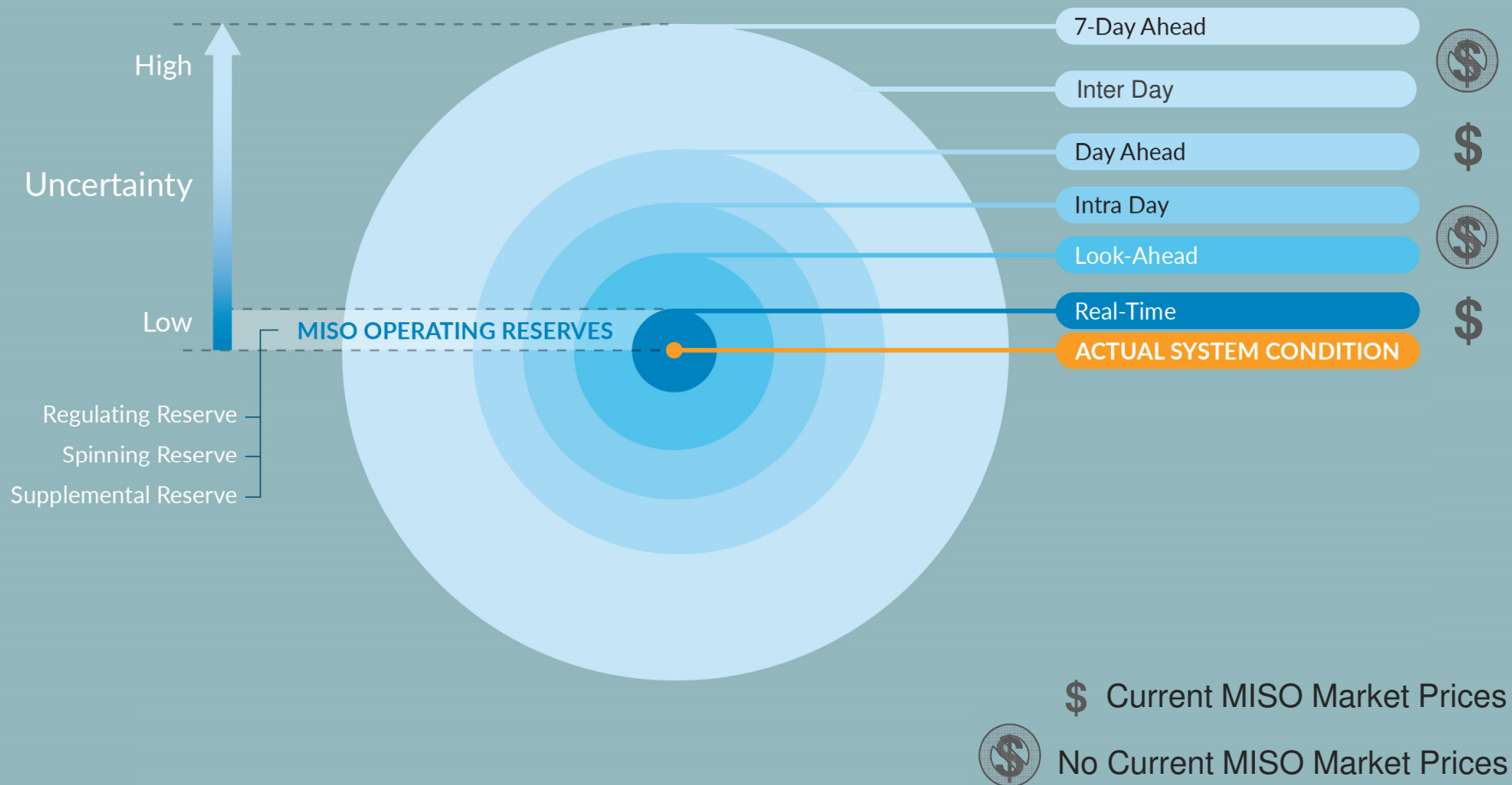


Managing Risk in the Grid Today & Tomorrow

ARPA-E PERFORM Workshop

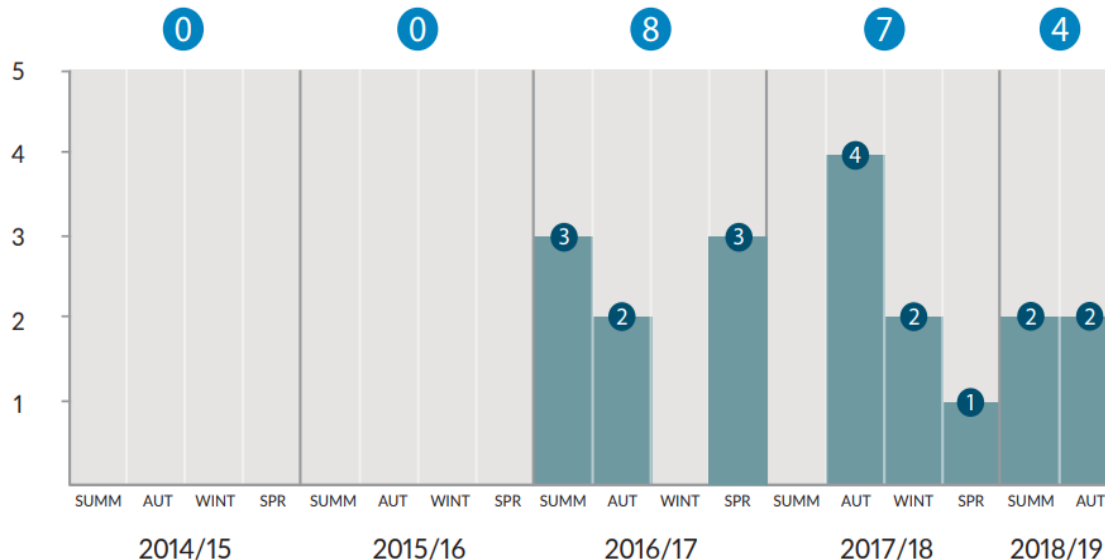
June 17, 2019

Grid operators take many actions over time to prepare for real time conditions



A series of procedures are also in place to address emergencies...

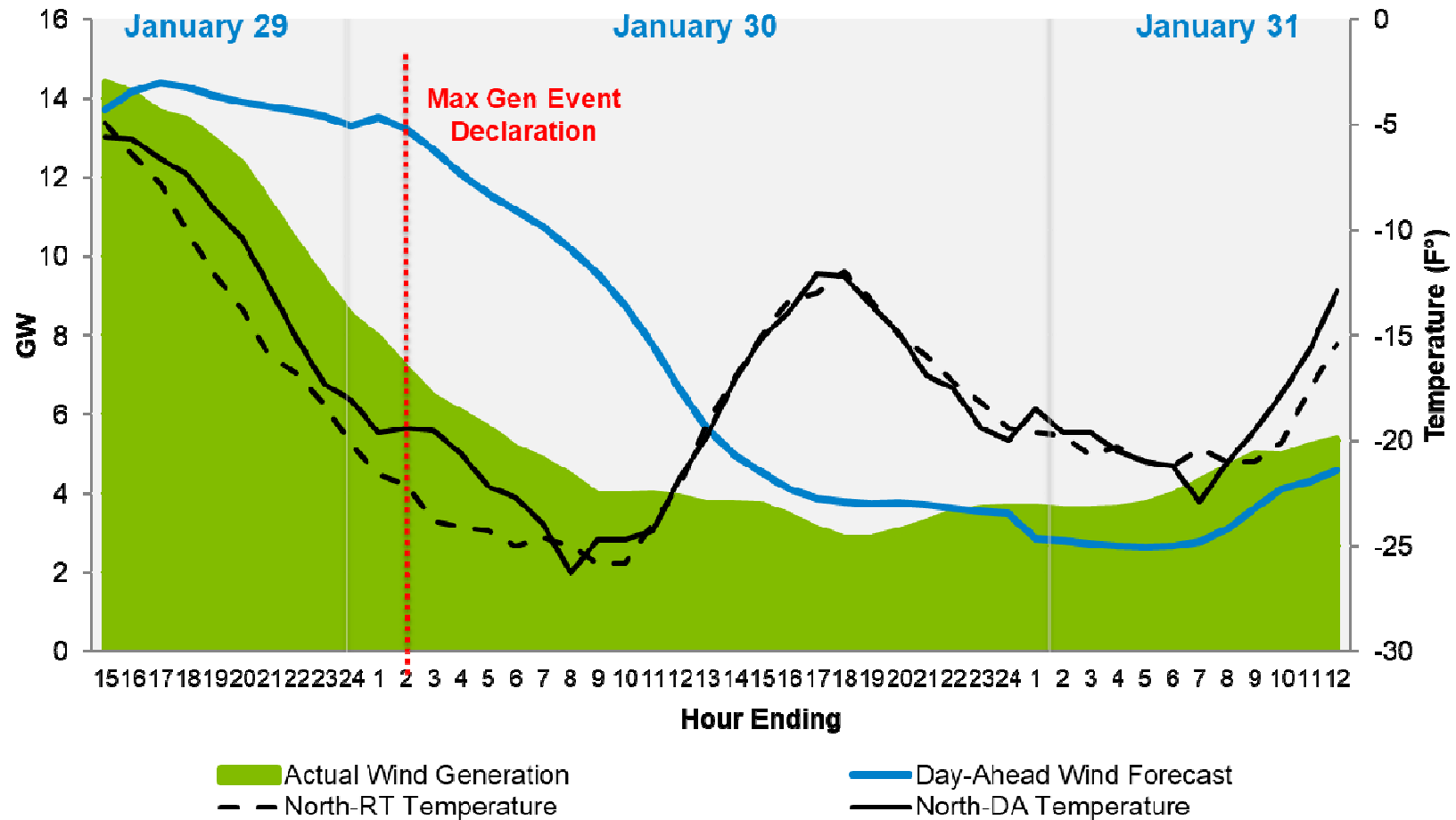
- MaxGen emergencies have occurred in all seasons but have not surpassed step 2



MISO's Maximum Generation Emergency Procedures



... as conditions can deviate from the expected



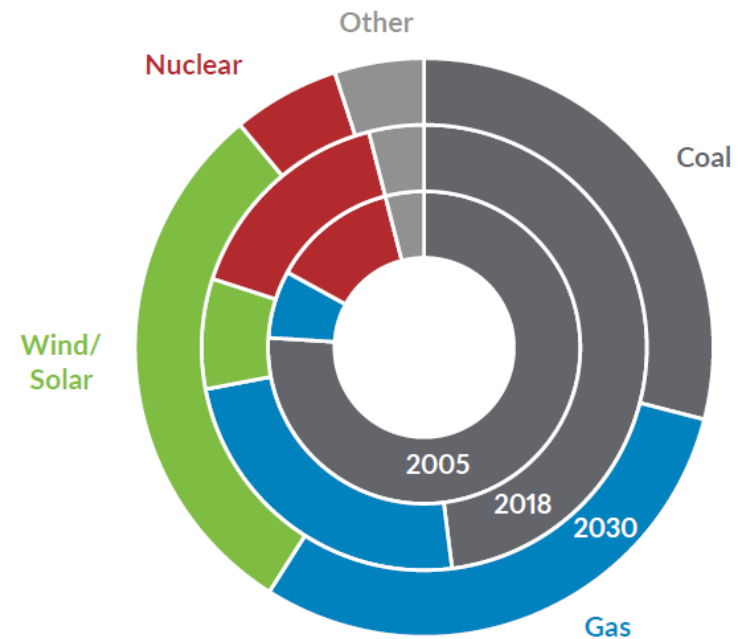
Gaps in availability & flexibility are expected to expand due to the combined effect of trends

Key industry trends

- Age and retirement of the portfolio's generating units
- High correlation in timing of planned outage for scheduled resources
- Growth in demand side and other emergency-only capacity as a percent of the overall portfolio
- Growing reliance on intermittent or unscheduled resources, including interchange
- Growth of variable energy resources as a major element of the fleet

MISO Energy Mix Transition (GWH) from 2005 to 2018 to 2030

***Based on Utility Announcements &
State Integrated Resource Plans****



*Chart reflects ratios of generation.

Effective market, operations & planning products, services & tools across time periods are necessary

SAMPLE SET OF NEEDS

